

**A new species of diminutive salamander (Amphibia: Caudata:
Plethodontidae: *Nototriton*) from the Montañas del Mico
of Guatemala**

David B. Wake and Jonathan A. Campbell

(DBW) Museum of Vertebrate Zoology and Department of Integrative Biology,
University of California, Berkeley, California 94720-3160, U.S.A.;
(JAC) Department of Biology, University of Texas at Arlington,
Arlington, Texas 76019-0498, U.S.A.

Abstract.—*Nototriton stuarti*, a new species of salamander belonging to the tribe Bolitoglossini, family Plethodontidae, is described from the Montañas del Mico, north of the Motagua Valley, in eastern Guatemala. The species is geographically isolated from congeneric species, and represents the northwestern-most record for the genus, which ranges from eastern Guatemala to central Costa Rica. This poorly known species is morphologically most similar to *Nototriton barbouri*, which occurs in northwestern Honduras.

Homoplastic evolution has produced diminutive, attenuate salamanders in many different clades of plethodontid salamanders in Middle America. These tiny species are difficult taxonomically and it has taken much effort to recognize that there are many more species than have been named throughout this region. New discoveries and new data have led to taxonomic revisions that are gradually identifying monophyletic groups, and as this process goes forward the generic level taxonomy has changed repeatedly. This is especially true of the genus *Chiropterotriton* Taylor, 1944, which as formerly recognized ranged from northeastern Mexico to Costa Rica, but which was not monophyletic and now has been fragmented into four genera (*Chiropterotriton*, *Cryptotriton* García-París & Wake, 2000, *Dendrotriton* Wake & Elias, 1983, and *Nototriton* Wake & Elias, 1983). At present diminutive plethodontids found to the north and west of the Isthmus of Tehuantepec are assigned to *Chiropterotriton* (Darda, 1994), but, in addition, all members of the genera *Parvimolge* Taylor, 1944, *Lineatriton* Tanner, 1950, and especially *Thorius* Cope, 1869, none closely related to

Chiropterotriton and all endemic to this area, are also diminutive. To the south and east of the Isthmus of Tehuantepec, extending as far as central Costa Rica, diminutive species are found in one well-supported clade (García-París & Wake 2000). This clade includes the genera *Cryptotriton*, *Dendrotriton*, *Nototriton* and *Oedipina*, and possibly the poorly known *Bradytriton* Wake & Elias 1983 (G. Parra-Olea, pers. comm.). *Oedipina* Keferstein 1868 includes some diminutive species, but also some large and relatively robust, although elongated, species. The phylogenetic diversity of this clade is now understood, at least in broad outlines. *Oedipina* and *Nototriton* appear to be the most deeply nested groups (García-París & Wake 2000), and they are also the most southerly in distribution, extending to Ecuador (moderately large species of *Oedipina* occur in South America, Brame & Wake 1963) and central Costa Rica, respectively. Both occur as far north as Guatemala, and *Oedipina* ranges into Chiapas, Mexico. *Cryptotriton* and *Dendrotriton* range from Honduras into Mexico, the former possibly even north and west of the Isthmus of Tehuantepec [the species

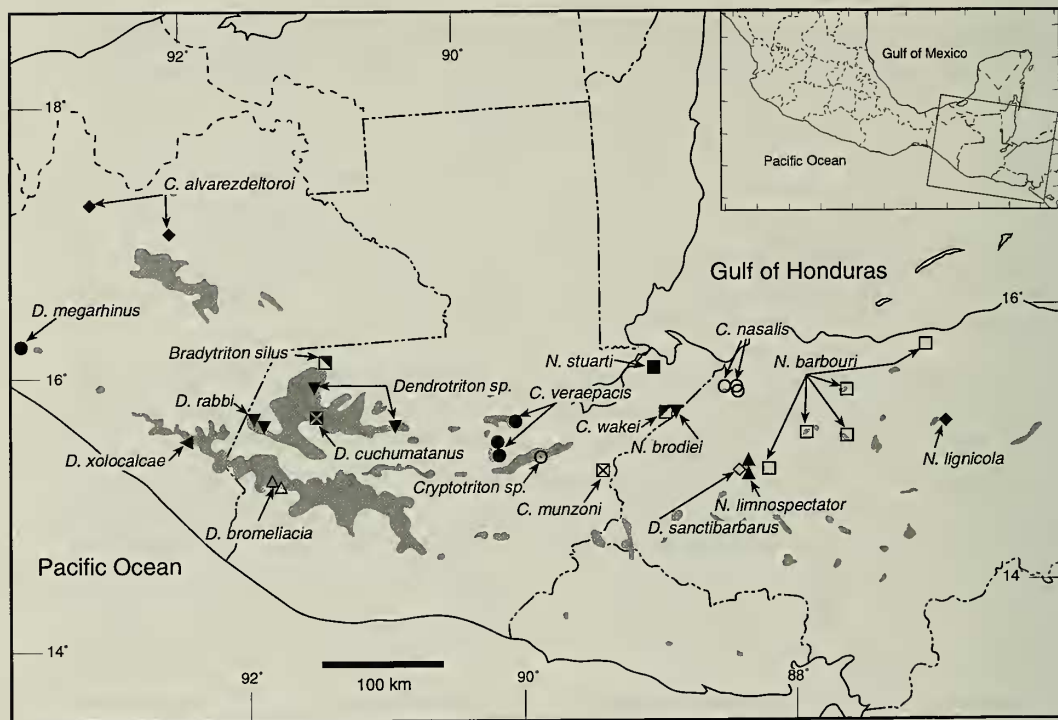


Fig. 1. Distribution of certain taxa discussed in the text from southern Mexico, Guatemala, and Honduras, showing the location of the type-locality of *Nototriton stuarti*. The map shows the location and degree of isolation of morphologically and ecologically similar, diminutive salamanders that have proven to represent several different smaller clades within a larger clade. Shaded areas on map represent regions with elevations in excess of 2000 m.

Cryptotriton adelos (Papenfuss & Wake, 1987) from northern Oaxaca is tentatively assigned to this genus], whereas *Bradytriton* is known only from its type-locality in western Guatemala (Fig. 1).

As revised by García-París & Wake (2000), *Nototriton* includes 11 nominal species, all diminutive (none exceeds 40 mm, snout-vent length), long-tailed forms that have small to moderately enlarged nostrils. Based on molecular data, the genus itself is well supported as a monophyletic group, and there are two well-supported internal clades, one including Costa Rican species, and the other including species from Honduras and Guatemala. The species *Nototriton richardi* (Taylor, 1949) from Costa Rica (and presumably its Costa Rican sister species *Nototriton tapanti* Good & Wake, 1993) is basal to one or the other of these

clades in different analyses, but the consensus view (allozymes plus mtDNA sequences) is that it is most closely related to the other Costa Rican species. The second clade includes one species described long ago but still little known biologically, *Nototriton barbouri* (Schmidt, 1936a), from northwestern Honduras, and three recently described taxa, *Nototriton lignicola* McCranie & Wilson, 1997 and *Nototriton limnospectator* McCranie, Wilson, & Polisar, 1998, the first from north-central and the second from western Honduras, and *Nototriton brodiei* Campbell & Smith, 1998, from extreme eastern Guatemala (Fig. 1). A single specimen representing another species belonging to this clade was collected in the Montañas del Mico in eastern Guatemala and at first confused with small specimens of sympatric *Oedipina elongata*

(Schmidt, 1936b). Fewer than 50 specimens are available for the second clade, but earlier taxonomic judgements based on morphology (McCranie & Wilson 1997, Campbell & Smith 1998, McCranie et al. 1998) have been supported by subsequent molecular studies (García-París & Wake 2000), so we are confident that this morphologically distinct form represents another new species.

Nototriton stuarti, new species
Stuart's Moss Salamander

Holotype.—UTA A-33686, an adult male from 11.6 km (road) WSW Puerto Santo Tomás, Montañas del Mico, Depto. Izabal, Guatemala, 88°40'W, 15°38'N, 744 m elev., collected on 6 Jan 1991 by Jonathan A. Campbell.

Diagnosis.—*Nototriton stuarti* is a member of a clade of northern species of *Nototriton*. It differs from all other members of the clade in having a broader head (0.14 times SL, from tip of snout to posterior angle of vent, whereas males of other northern species have the following values: *barbouri* 0.12, *lignicola* 0.11, *limnospectator* 0.11) and fewer maxillary teeth (36, versus 48–60 in other northern species). It is further distinguished from *lignicola*, *limnospectator*, and *barbouri* by having a larger nostril (0.012 times SL, versus 0.005–0.011 in *barbouri*, 0.005–0.016 in *brodiei*, 0.006–0.009 in *lignicola* and 0.003 in *limnospectator*), although the nostril is small in comparison with some Costa Rican members of the genus. It differs from some species in having longer limbs (combined limb length 0.35 times SL, versus 0.31–0.33 in *brodiei* and 0.30–0.34 in *lignicola*) and narrower feet (foot width 0.05 times SL, versus 0.06 in *barbouri* and *brodiei* and in male *limnospectator*).

Description.—This species is known from a single individual that is about average in size for the genus (32.6 mm, SL). It has small nostrils (0.012 times SL) and a broadly rounded snout (but narrow for an

adult male) of moderate length. The nasolabial protuberances are modest in size and barely protrude below the upper lip. The narrow head has eyes of moderate size that are only slightly protuberant, barely extending to the margin of the jaw. The parotoid glands are distinct but relatively small. The head is rounded rather than flattened, and is little differentiated from the neck and anterior body. Maxillary teeth are relatively numerous (36 in the holotype, with 4 premaxillary teeth), and there are moderate numbers of vomerine teeth (20). The limbs are short (combined limb length SL = 0.35), with narrow hands and feet that bear short, poorly developed digits. The digits are partly fused basally and the outer digits are very short. Digits 2 and 3 of the hand and 2, 3, and 4 of the foot are narrow and have pointed tips. The tail is long (1.26 times SVL) and tapered, with little evidence of basal constriction. The tail is stout basally and is of the same diameter as the posterior end of the body.

Measurements of holotype (in mm).—Snout-vent length 32.6, tail length 41.2, tail depth at base 3.3, tail width at base 3.2, distance between forelimb and hind limb insertions 19.4, trunk width just posterior to forelimbs 3.7, distance from tip of snout to gular fold 6.2, head width 4.5, head depth 2.5, distance between eye and nostril 0.9, elliptical nostril 0.4 × 0.2, distance between nostrils 1.1, eye diameter 1.6, interorbital distance 1.8, forelimb length 5.6, hindlimb length 5.8, width of hind foot 1.6, third toe length 0.4, fifth toe length 0.1.

Osteology.—Information has been obtained from radiographs of the holotype. The skull is relatively well developed, and in general resembles the skulls illustrated for Honduran species of the genus by McCranie et al. (1998), but with some important distinctions. The nasals are relatively large and are fragmented along the anterior margin. The nasolacrimal foramen is clearly evident and is surrounded by bone, but it is unclear if the nasolacrimal duct pierces the prefrontal bone (as in the genus

Cryptotriton) or if the nasal forms the anterior margin of the foramen and the prefrontal the posterior margin (as in some other species of *Nototriton*). The prefrontal is present because there is bone posterior to the duct opening and that bone is separated from the facial process of the maxillary. The premaxillary has a moderately well developed dental process, and paired ascending processes that are not fused basally, remain separated for their entire length, and which are not expanded terminally. The ascending processes are relatively short. No septomaxillary is evident. The maxillaries are relatively long and slender, extending to the posterior margin of the relatively small eye. The preorbital process of the vomer is long and well developed, and bears teeth in a single row. The frontals and parietals are well developed and there is only a small gap that barely qualifies as a mid-dorsal fontanelle. No cranial crests are evident. No columellar process can be seen on the operculum. There are 14 trunk, one sacral, and two caudosacral vertebrae. The tail is incomplete and is regenerating; it may have regenerated twice. The phalangeal formula of the forelimbs is 1-2-3-2, hind limbs 1-2-3-3-2 (digit three is incomplete on one foot). The digits are all well formed. Terminal phalanges of the longest digits are slightly expanded. There is a well-developed tibial spur.

Coloration (in alcohol).—The dorsum of the head, trunk and tail is dark reddish brown, with a series of prominent whitish chevrons (pointing cranially) covering the back. The head is somewhat mottled, with pale patches on the eyelids, between the eyes, and on the temple region, as well as on the nasolabial protuberances. A row of small pale spots creates an irregular and inconspicuous stripe along the upper ventrolateral surface of the flanks. A pair of poorly formed pale spots is found just anterior to the tail base constriction. Irregular whitish spots mark the tail dorsum, and the limbs have abundant small whitish spots. The ventral surfaces are paler than the dor-

sum and are relatively uniform pale gray, but there are some obscure whitish spots on the throat.

Habitat.—The holotype of *N. stuarti* and several specimens of *Oedipina elongata* were found inside logs at the type-locality, and initially the specimen described here was thought to be a member of that taxon. One of this series of salamanders was found dead on a trail, and it may have been in leaf litter and stepped on by collectors earlier in the day.

In contrast to higher, more extensive mountain ranges in Guatemala, the Montañas del Mico do not possess well defined vegetational belts, although above 600 m a lush subtropical wet forest prevails. Cloud forest occurs in the vicinity of the type-locality of *N. stuarti* and on the two highest peaks in the region—Cerro San Gil and Cerro Las Escobas.

The Montañas del Mico are one of the wettest regions in Guatemala. Although weather stations are lacking in these mountains, the lowlands just to the north receive in excess of 4000 mm of precipitation per year (INSIVUMEH 1992), and it is likely that an even greater amount of rain falls on the windward slopes of the Montañas del Mico.

Distribution.—*Nototriton stuarti* is known only from the type-locality (Fig. 1) in the Montañas del Mico, which reach a maximum elevation of 1267 m on Cerro San Gil. These geographically isolated uplands are located to the north of the inhospitable valley of the Rio Motagua and are surrounded by lowland, tropical habitats. To the southwest, a low ridge system (>300 m) connects the Montañas del Mico with that of the Sierra de las Minas.

Etymology.—The species is named in honor of the late L. C. Stuart, who spent his scientific career studying the amphibians and reptiles of Guatemala, and who predicted that the Montañas del Mico would produce a previously undescribed species of salamander.

Comments.—*Nototriton stuarti* repre-

sents the northwestern-most member of the revised genus (García-París & Wake 2000). The species is morphologically distinct, but the differences separating it from other species are subtle. Its closest geographic neighbor is *N. brodiei*, which it resembles in body and nostril size, but it differs markedly in having a shorter tail, fewer teeth, and broader head. Both species, as well as others (often only some individuals of a species) in the genus, have a dorsal color pattern of pale marks arranged in a herringbone pattern. Its morphological characters are matched most closely by those of *N. barbouri*, possibly for the simple reason that that species is known from the largest sample.

Acknowledgements

We thank M. B. Harvey, W. W. Lamar, D. P. Lawson, and E. N. Smith for their participation in field work in Guatemala. Gabriela Parra-Olea shared unpublished molecular data. We are appreciative to the officials of the Consejo Nacional de Areas Protegidas (CONAP), who issued collecting and export permits. The material is based in part upon work supported by the National Science Foundation (DEB-9705277) to JAC.

Literature Cited

- Brame, A. H., Jr., & D. B. Wake. 1963. The salamanders of South America.—*Contributions in Science*, Los Angeles County Museum 69:1–72.
- Campbell, J. A., & E. N. Smith. 1998. New species of *Nototriton* (Caudata: Plethodontidae) from eastern Guatemala.—*Scientific Papers, Natural History Museum, University of Kansas* 6:1–8.
- Cope, E. D. 1869. A review of the species of the Plethodontidae and Desmognathidae.—*Proceedings of the Academy of Natural Sciences, Philadelphia* 1869:93–118.
- Darda, D. M. 1994. Allozyme variation and morphological evolution among Mexican Salamanders of the genus *Chiropterotriton* (Caudata: Plethodontidae).—*Herpetologica* 50:164–187.
- García-París, M., & D. B. Wake. 2000. Molecular phylogenetic analysis of relationships of the tropical salamander genera *Oedipina* and *Nototriton*, with descriptions of a new genus and three new species.—*Copeia* 2000:43–70.
- Good, D. A., & D. B. Wake. 1993. Systematic studies of the Costa Rican Moss Salamanders, genus *Nototriton*, with descriptions of three new species.—*Herpetological Monographs* 7:131–159.
- Instituto Nacional de Sismología, Vulcanología, Meteorología e Hidrología (INSIVUMEH). 1992. Datos Meteorológicos de las Cabeceras Departamentales. Gobierno de Guatemala, 195 pp.
- Keferstein, W. 1868. Über einige Batrachier aus Costa Rica.—*Archiv für Naturgeschichte* 34:300, pls. 8–9, figs. 8–9.
- McCranie, J. R., & L. D. Wilson. 1997. Two new species of salamanders (Caudata: Plethodontidae) of the genera *Bolitoglossa* and *Nototriton* from Parque Nacional La Muralla, Honduras.—*Proceedings of the Biological Society of Washington*. 110:366–372.
- , ———, & J. Polisar. 1998. Another new montane salamander (Amphibia: Caudata: Plethodontidae) from Parque Nacional Santa Barbara, Honduras.—*Herpetologica* 54:455–461.
- Papenfuss, T. J., & D. B. Wake. 1987. Two new species of plethodontid salamanders (genus *Nototriton*) from Mexico.—*Acta Zoologica Mexicana (nueva serie)*. 21:1–16.
- Schmidt, K. P. 1936a. New amphibians and reptiles from Honduras in the Museum of Comparative Zoology.—*Proceedings of the Biological Society of Washington* 49:43–50.
- . 1936b. Guatemalan salamanders of the genus *Oedipus*.—*Field Museum of Natural History, Zoological Series* 20:135–166.
- Tanner, W. W. 1950. A new genus of plethodontid salamander from Mexico.—*Great Basin Naturalist* 10:37–44.
- Taylor, E. H. 1944. The genera of plethodont salamander in Mexico, pt. 1.—*University of Kansas Science Bulletin* 30:189–132.
- . 1949. New salamanders from Costa Rica.—*University of Kansas Science Bulletin* 33:279–288.
- Wake, D. B., & P. Elias. 1983. New genera and a new species of Central American salamanders, with a review of the tropical genera (Amphibia, Caudata, Plethodontidae).—*Contributions in Science, Natural History Museum of Los Angeles County* 345:1–19.